



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

not so regular in form, it being much longer than broad. To the west we can see nothing but similar mountains. Being limited for time, we visited but the two mountains.

The following is a section made from the "North Peak," on the east slope:

No.		
37.	On the summit of the mountain soil is found five or six feet in thickness, and in this were growing a dozen or more species of Western flora.	+6 196
36.	Under the soil is a cap of white gypsum rock which is found in both of the mountains visited, and probably accounts for the erosion having taken place as it has.	10 186
35.	Blue clays.	2 184
34.	Red clays, with layers of gypsum and sandstone.	10 174
33.	Clay and gypsum.	2 172
32.	Clayish, red sandstone.	10 162
31.	Red clay, containing stripes of blue.	6 156
30.	Shaly sandstone.	2 154
29.	Red clay.	5 149
28.	Shaly sandstone.	2 147
27.	Red clay, containing gypsum.	30 117
26.	Gypsum rock.	1 116
25.	Red clay, containing gypsum.	30 86
24.	Gypsum in thin layer.	
23.	Red clay.	5 81
22.	Gypsum like No. 24.	
21.	Red clay.	3 78
20.	Blue clay.	2 76
19.	Red clay containing gypsum.	6 70
18.	Thin layer of gypsum.	
17.	Red clay.	4 66
16.	Gypsum like No. 18.	
15.	Red clay.	4 62
14.	Blue clay striped with red.	2 60
13.	Red clay.	6 54
12.	Thin layer of gypsum.	
11.	Blue clay, blending with red.	4 50
10.	Gypsum layer, like No. 12.	
9.	Red clay.	10 40
8.	Gypsum like No. 12.	
7.	Red clay.	5 35
6.	Gypsum like No. 12.	
5.	Red clay.	5 30
4.	Gypsum like No. 12.	
3.	Red clay.	4 26
2.	Blue clay.	2 24
1.	Red clay and covered slope of the plain.	+40 0

Comparing this section with sections made by Professor Prosser in the "Cretaceous-Comanche Series of Kansas,"* from the Medicine Lodge regions, I conclude that the formation is very similar to that found about Medicine Lodge, Kan.

KANSAS MINES AND MINERALS.

BY G. P. GRIMSLEY, WASHBURN COLLEGE, TOPEKA.

A lecture delivered before the Academy, at Topeka, December 28, 1900.

Industry and painstaking patience have changed the grass-covered, open prairies of Kansas into a land of waving wheat and corn, which yield their annual harvests of golden grain. Fertile soil, rain and bright sunshine have in this area solved the problem of the ancient alchemists and have converted earth into gold. Here the cow, steer, hog and "helpful hen" have found a congenial home, and have added their quota to the wealth of the state, helping to usher in the reign of prosperity for Kansas. This surface wealth is clearly seen, and attracts the attention of the stranger within our gates as well as the home-loving native.

The agricultural story is told over and over again, always with added interest; but the wealth below the reach of the light of day, gathered by the steel fingers of the pick and drill—the hidden treasures—is too much overlooked, even by our own citizens; so it is no wonder that this storehouse below the soil is almost an unknown factor to the people outside our borders.

*Univ. Geol. Surv. of Kansas, vol. II.

Gold and silver, like the prophets of old, we have none; but we do possess mineral in abundance, which is readily exchanged for these precious metals which the world so zealously strives to obtain.

Geologists and explorers have talked and written about Kansas from early days. Fossils and rock strata have been described by them in learned terms, often unintelligible to the masses, but yet holding a dignified position in the annals of science.

Lewis and Clarke, those intrepid explorers, early in our century made their perilous way to our country's western border. As they passed across the plains of Kansas they noted the occurrence of limestone, clay, and coal; but it was not until the dark and stormy days of the war of emancipation had closed that an organized survey of our mineral resources was made.

In 1864 Prof. B. F. Mudge began his labors as director of the geological survey of Kansas, and published a report on the coal and salt deposits. The survey was maintained only two years, and it was not resurrected until 1895, when the present University Geological Survey was organized.

In the long interval between the surveys individual geologists and prospectors advanced the knowledge and development of the state's mineral deposits. It was during this period that the Kansas Academy of Science was of special value to our state in fostering the scientific spirit and furnishing a medium of publication. These reports and those of the state survey furnish accurate and valuable descriptions of our mines and minerals.

It is fitting that, on the dawn of this coming century, we pause in our routine of work and look back over the past history of our mineral development and take an invoice of our present resources. Only a score of years ago three minerals were mined in Kansas: coal, building stone, and some zinc, with a value of about one million dollars. To-day, in addition, we have salt, gypsum, oil, gas, mineral water, clay, natural cement rock, Portland cement materials, with a value of nearly twenty million dollars a year, or, with the Argentine smelter, of thirty-nine million dollars. Many of these products are in the infancy of their development, and none is worked to its fullest capacity. New industries have started this year, and a number have been planned for the coming year. Kansas is on the up grade in mineral development.

COAL.

Coal and iron are the foundation stones upon which the greatest industrial progress of the nineteenth century rests. Not until the seventeenth century did England and Europe realize the value of this rock fuel, and about a century later coal was mined near Pittsburg, Pa.

In Kansas coal was about the first deposit to attract attention, and it is now our most important mineral. Thirty-five years ago the settlers of Cherokee county warded off the chilly blasts of winter by fires of coal taken from the neighboring creek banks. The largest hoisting shaft in the state, and probably in this country, is found at the present time at Chicopee, in Crawford county, which is the banner coal county of the state, sending out, with Cherokee, over eighty per cent. of the total coal supply which comes from twenty-nine counties. Ninety-eight per cent. comes from six counties: Cherokee, Crawford, Bourbon, Leavenworth, Osage, and Labette. In southeastern Kansas there are about thirty separate coal-veins, ranging from eight inches to nearly four feet in thickness. There are 250 coal-mines in the state, with a depth of a few feet to 720 feet, at Leavenworth. Two thousand two hundred feet above the base of the lower coals comes the Osage coal, accidentally discovered in 1869 in digging a well near Carbondale, and mined at various places along the Santa Fe railroad.

Above this horizon no coal in paying quantities is found in the Coal Measures of the state.

The Coal Measure rocks, on account of their varied character, often form scenery of great beauty. Compare, for example, the view of the Ohio measures with a view in the Coal Measures of this county, a scene on the Shunganunga.

The area covered by Coal Measure rocks in Kansas is 20,000 square miles. The state survey has estimated that, with all allowances, 40,000 square miles are coal producing, with an average of two and one-half feet of coal, which would yield perhaps eight billion tons. At the present rate of mining, this would last 2000 years, and, at the average price for the past ten years, would have a value of twelve billion dollars. It is difficult for the mind to grasp the meaning of such figures, and yet this is only one of our minerals.

NATURAL GAS.

Just twenty years ago the industrial world awoke to the fact that another form of stored fuel existed in the deep recesses of earth, and the natural gas excitement was ushered in, reaching its height about 1886. The northern Ohio farm lands took on the aspect of mining camps, and small villages grew rapidly into manufacturing cities. Coal had a new rival, and the wheels of industry were now to be run with a more convenient fuel. Blind folly decreed that the supply was inexhaustible, and the flaming street torches marked the gas cities by day and lighted the race-tracks with a circle of fire by night.

Some prophetic sages predicted that disaster would follow when wanton people were destroying the fuel which a higher power had concealed for the final destruction of this world; and the wasteful extravagance did cause disaster, but in another way. To-day, in many of these districts of the East, the gas-pipes are rusting in the streets; the race-tracks are dark and deserted at night; the dark-faced fireman again stands before the furnace door; and the troublesome coal bills again loom up before the weary eyes of the man of the house, who now has to carry the full coal pail. The lesson was learned, often too late, that this valuable fuel was limited, and that its day was brief even where carefully used.

We have in Kansas some valuable gas and oil fields, and the sad experience in the East has had its influence; so that there is not such reckless waste, but the waste is there. It is to be feared that some future day our cities will regret the burning house and street lamps day and night, as one sees in our gas belt. It is stated that it is cheaper to burn the gas than to buy matches, which represents poor economy. Meters are never used, and the charges are made by the month.

The Iola gas field has a length of ten miles and a width of at least four miles, with a total capacity at the present time of 200,000,000 cubic feet in twenty-four hours, which would be equivalent to nearly 10,000 tons of coal a day, or equal to the total coal production of the state. It is very difficult to determine how much gas is used a day for all purposes in the Iola field; but it certainly is not far from 17,000,000 cubic feet; so there is a heavy reserve not disturbed. These wells are drilled to a depth of 815 and 920 feet and the rock pressure of the gas, as measured by a gauge, is 315 to 325 pounds to the square inch. This is the motive power which forces the gas out of the wells and through the pipes. The drills cannot be driven more than fifteen or eighteen feet into the gas sand, for the pressure is so great that the tools, though weighing over a half ton, will not sink. As the gas escapes from the open well the roar is deafening, and can be heard for miles.

The Coffeyville gas field has been developed over an area of seven by three miles, and of the fifty-four wells drilled forty-four are productive in greater or less amount. The Cherryvale field is being rapidly developed and new industries

are starting here as well as at Chanute. Other important fields are found at Independence, Paola, Chetopa, and Erie. This whole area, estimated at nearly 9000 square miles, with its excellent railroad facilities, promises to become an important manufacturing district.

As to the duration of this supply very little can be said; the newspaper comments from time to time about the gas rapidly giving out in these areas have very little foundation. In Iola wells which have been used constantly for the past six years have lost ten pounds pressure, but when closed for a few days regain part of this amount. With this loss they still have 300 pounds pressure, and a large smelter would only require about eight ounces a day. With care, these fields ought to last for a long time, and it is safe to say that there will be gas in Kansas when the eastern fields have been abandoned. Our state ranks about fourth among fourteen gas states in value of gas utilized, but only a very small fraction of the available supply is yet used. During the past year some very wealthy companies have obtained control of the fields and development on a large scale will soon follow.

OIL, OR PETROLEUM.

One of the latest mineral industries to be developed in the state is that of coal-oil. Its discovery, however, dates back over thirty-five years, to the early days of Kansas. The "Pike's Peak or bust" gold hunter and other "Westward, ho!" emigrants camped in Johnson county, and bought for wagon grease the heavy, dark oil which was skimmed from the surface of a well dug for water. In 1860 the Oil creek, Pennsylvania, excitement reached its height, and a new industry was opened in the United States, which has served as a basis for immense fortunes and has resulted in the formation of America's greatest trust. In 1871 the wave of this excitement reached Kansas, and a well was drilled at Paola, resulting in the discovery of gas, but no oil in paying quantity. Twenty years later, at Independence, wells were sunk to a depth of 884 feet, resulting in the discovery of a large oil field. The developed oil field is in Wilson and Neosho counties, where a million dollars has been expended and seventy oil wells drilled, near Neodesha, Humboldt, Thayer, Sedan, Guilford, and Buffalo, with a daily flow of ten to fifty barrels each. The oil is carried in pipe lines to a large oil refinery, at Neodesha, which has been in operation for three years. The field is owned by the Standard Oil Company, and only a small amount of the supply is used at the present time; but the state holds eighth rank among fourteen districts of the United States.

LEAD AND ZINC.

The second mineral in importance in Kansas is zinc; and as lead is so closely associated with it, the two are considered together. The deposits in Cherokee county were discovered in 1868, then forgotten, and rediscovered in digging a well in 1876. This discovery was followed by great excitement. Thousands of people flocked in, fortunes were made and lost, and the mining camps grew into the cities of Galena and Empire City, under which extend the tunnels of many mines, and the hoisting shafts are dotted through the towns. Few men in those days even suspected that Kansas was soon to become the second state in the union in zinc smelting, and that the markets of the world would be controlled, to a large extent, by those shafts in the Short Creek valley.

The lead- and zinc-producing area of Kansas is not large in surface extent, covering about sixty square miles in the southeastern corner of the state, in Cherokee county, and near the Missouri line. The main mines are within the towns of Galena and Empire City, where the ores, mixed with white- and dark-colored flints, are obtained in shafts 50 to 120 feet deep. In 1878, 143 tons of lead ore

were removed, but no zinc. In 1899, 6700 tons of lead and over 64,000 tons of zinc ore were mined in this area. Most of the lead ore is smelted outside the state, while the zinc ore was smelted at Pittsburg, Weir City, and Girard; but now nearly all of it is smelted within the gas belt, at Iola, Gas City, and Cherryvale. The great smelting company of the Southwest was the Cherokee-Lanyon company, whose Pittsburg works are now being torn down, as the company has been consolidated with others at Iola under the name of Lanyon Zinc Company. In and around Iola there are 23 blocks, of 600 retorts each, for the smelting of zinc. These works are the largest in the United States, and will soon be the largest in the world. The daily production of metallic zinc, or spelter, as it is called, is nearly 200 tons, which requires 400 tons of ore, and, if gas was not used, would consume about 1200 tons of coal. This represents nearly one-half of the total production of the United States. Among the states of the union, Kansas stands a close second to Illinois in production of metallic zinc.

SALT.

One of the necessities of life is salt, the record of whose discovery is lost in antiquity. Nature has dealt kindly in its distribution, for it is found almost everywhere over the world and in rocks of all geological ages. In the early days of Kansas, salt was obtained by the evaporation in kettles of water from the salt marshes located near the borders of the present developed salt area in Republic, Cloud and Jewell counties. The first salt well was used in 1867, at Solomon City, and the brine evaporated by the sun's heat. These Solomon wells are in use today, and this is the only locality in the state where salt is obtained by the solar process.

Out of the wreck of the disastrous boom excitement of 1887-'88 some good results came to Kansas. One of these was the development of the salt industry at Lyons, Hutchinson, Sterling, Kanopolis, and Kingman. At Lyons prospect holes were drilled for oil and gas, resulting in the discovery of 300 feet of salt, at a depth of 700 feet. This is now mined at Kanopolis, Lyons, and Kingman. The quality is shown by analysis be 99.93 per cent. pure. At Hutchinson and Sterling, salt is obtained from brine, in wells 700 feet deep. The brine is evaporated by artificial heat, in pans, either by means of direct heat or by steam. The daily capacity of these brine plants is not far from 5000 barrels, though the present demand will not permit the works to run at their full capacity.

The Kansas salt beds extend from Ellsworth and Saline counties southward to the southern line of the state, and in breadth cover from two to three counties, and there is evidence of salt outside of this area. The state holds third rank, after New York and Michigan.

GYPSUM.

Often associated with salt is found the sulphate of lime, or gypsum, which is burned into plaster of Paris or cement wall plaster. In this manufacture Kansas has first rank among the states, on account of the high quality of the materials and the skill in manufacturing. Sixty thousand tons are used a year, and the value of the product is \$263,000.

The gypsum deposits form a belt tending northeast-southwest across the state. The belt of exposed rock varies in width from five miles at the north to fourteen in the central part, and thirty-six miles near the southern line, with a length of nearly 230 miles. This area is naturally divided into three districts: The northern or Blue Rapids area, in Marshall county; the central area, in Dickinson, Marion, and Saline counties; the southern or Medicine Lodge area. These

deposits have been described in detail by the writer, forming volume V of the University Geological Survey reports.

The first deposits of gypsum rock worked in the state were in the northern area, where, in 1872, at Blue Rapids, the Coon brothers built a frame shed on the Blue river and commenced the manufacture of plaster of Paris in a five-barrel kettle heated by a stove. Prosperity seems to have attended their work; for three years later they built a stone mill on the west bank of the river, using the water-power, probably the best in the state, for grinding. This mill, though no longer in use, is still standing, a monument to the opening of a great Kansas industry. The mills in this area and one in the central area use the massive white gypsum rock, while the others in the central area use the loose gypsum earth, which is known as agatite, aluminite, and the like. This earthy variety was worked at Gypsum City, Rhodes, and Dillon, and is now used at Burns, Marion county, Mulvane in Sumner, Springvale in Barber, and Longford, Clay county.

The Medicine Lodge area, with its continuation southward into Oklahoma and Texas, forms one of the largest gypsum deposits in the United States. It is traversed by the Santa Fe railroad, and there are only two small mills located there at the present time. Near the town of Medicine Lodge gypsum rock caps the hills as a layer twenty-five feet in thickness, protecting the underlying soft red clays and shales, thus causing a most rugged topography, often likened to the "Bad Lands" of the Northwest.

The term "low, monotonous prairies of Kansas" has no application to the gypsum belt. When the setting sun reflects its light against the red shales crowned by the white gypsum rock, it forms a scene of beauty which attracts the attention of every traveler through that region. The cañons, often 200 feet in depth, are dry during most of the year, but after a summer thunderstorm they are filled with a tumultuous flood of sand-laden waters.

In the Eastern states the gypsum rock is ground mainly for fertilizer, but in Kansas it is ground and burned into plaster of Paris for casts, molds, and white finish for walls. This plaster sets in a very few minutes; but it is possible, by adding certain mixtures, to retard the set four to six hours, and the resulting product is sold under the name of cement wall plaster. This forms a hard, firm wall, which dries rapidly and is nearly fire-proof. Some of the large buildings in Chicago and Kansas City have used 2000 and 2500 tons of Kansas plaster, and the demand is increasing each year as the advantages are recognized.

CLAY.

Even the dust under our feet has a value, especially if we are standing in certain places in the state. Earth, mud, or, to speak more technically, clay, which has been properly fashioned, and has emerged from the flames, passes through the hands of the mason into stately architecture. The total value of clay products in the United States is about sixty million dollars, of which one-half represents building brick. This brick would make a walk ten feet in width around the entire globe.

One of the clay industries which has made remarkable growth in the last few years is the manufacture of vitrified brick for street paving. This industry has become especially important in southeastern Kansas, at Pittsburg and the towns in the gas belt. There are now thirteen factories of paving and building brick—three at Iola, two at Chanute, and one in Humboldt, Cherryvale, Coffeyville, Independence, Neodesha, Pittsburg, Girard, and Columbus. Other large plants are found at Atchison, Lawrence, and Topeka.

Common building brick were about the earliest clay products made. The necessary materials were wide-spread, and no great skill is required in their manu-

facture; so that brick-kilns and yards are familiar objects. Many towns in Kansas have such kilns, either in operation or abandoned after they had supplied the home trade. The tough gumbo clays are now burned for railroad ballast at a number of places in the state, on account of its cheapness, and its dustless and elastic properties. In Missouri this industry *alone* amounts to one million dollars annually. There is a large pottery at Coffeyville, and a roofing-tile works is nearing completion at Cherryvale. There are deposits of fire-clay which have not as yet been developed. The total value of Kansas clay products is over \$400,000 a year, and over half of the value is in building brick, and about forty-five per cent. paving brick.

HYDRAULIC CEMENTS.

The ordinary limes will not set under water; and when they are exposed to aqueous or water action, become disintegrated. It was early discovered that certain limes would become hard even under water, and they were called hydraulic limes or hydraulic cements. Where the lime rock is burned directly into cement, the product is called natural cement; but where a mixture of limestone and clay or shale is used, the cement is called artificial or Portland, so named from its resemblance to the famous Portland stone of England, used in Westminster Abbey. The United States leads the world in natural-cement manufacture. In Kansas we have a deposit of natural-cement rock equal to the best in this country. This is located near Fort Scott, where there are two companies, with two mills having a daily capacity of 850 barrels of cement. This cement is held in high favor in Kansas City, and has a large market in all the surrounding states, and the Kansas demand is increasing.

The impression among our contractors that Fort Scott cement is inferior to other brands of natural cement is not supported by tests or by experience. The strength of this cement after seven days has been shown to be greater than any other natural cement made in other states.

For many kinds of work, the Portland cements are preferred to the natural. It has not been many years since all of this product was imported from England and Germany; but now it is made at a number of places in this country. Imports of cement have been decreased thirty to fifty per cent. in the last three years; the capacity of American plants has doubled.

The writer, three years ago, made a report of cement locations in Kansas for the Santa Fe industrial department, and recommended a location at Iola. Two years afterward the Portland Cement Company broke ground for one of the largest cement mills in this country, and on the 16th of last June the first cement was made at this mill. Over 1000 cars of building material and machinery were brought in for the four large, fire-proof buildings. Gas is used a direct motive power in the largest gas-engines of the West. There are six 350-horse-power Westinghouse gas-engines, and three 150-horse-power, or a total of 2500 to 3000 horse-power.

BUILDING STONE.

Only two kinds of rock are quarried in Kansas for building stone—limestone and sandstone. About one-half of the limestone of our country, according to value, is burned for lime, and even more is used for building and road material. The Kansas product is used mainly for the latter purposes. Most of the production comes from near the towns of Manhattan, Atchison, Leavenworth, Topeka, Strong City, Cottonwood Falls, Marion, Augusta, Winfield, Arkansas City, and Fort Scott. The largest quarries in the state are at Strong City and Cottonwood Falls. Sandstone is found in all parts of the state in greater or less amount, but the productive portions are in the southern and northwestern parts of the state.

This review of the Kansas mineral resources should give us a higher opinion of our state. The record of the past is one in which we can well take pride, and it is to be hoped that this is but the beginning of greater things to come. New mills are now building, new deposits are now being uncovered, and progress is sure to follow.

THE FLINT HILLS OF KANSAS.

BY J. R. MEAD, WICHITA.

Read before the Academy December 28, 1900.

In this article I shall not attempt to give the geology of the Flint hills. I simply give my observations of years past in a general way.

The so-called "Flint hills" extend through the counties of Chase, Butler, Cowley, and the northwest part of Greenwood, and south through the Kaw reservation, where they merge into sandstone. Their summits are in range 8 east of the sixth principal meridian. North of the Cottonwood they appear to merge into the general line of the uplands. The same strata of rock probably extend northward through Morris and Wabaunsee counties. These hills are the culmination and eastern end of the Upper Carboniferous formation, which, rising toward the east on these hills, reach a general altitude of 1600 feet. In Butler county the eastern declivity is abrupt, and the many ravines descend sharply to the valley of Fall river. From Beaumont, on the summit, to the mouth of Fall river, a distance of fifty miles eastward, the fall is 800 feet. The Flint hills are the result of erosion and not an anticline. In the general wearing down of the various strata once overlying Kansas, nature here formed layers of hard, solid, silicified limestone, effectually stopping the further progress of erosion, as did the massive gypsum which caps the hills of Barber and Comanche counties. This wearing away continued on either side, until the valley of Fall river was formed on the east and the Walnut river to the west, leaving these hills high in the air; yet the approach from the west is so gradual and uniform it is hardly noticeable. A fine exposure of this limestone is found along the bluffs bordering the south fork of the Cottonwood on the east, where along the slopes of the ravines may be seen blocks of stone ten by fifteen to twenty feet, and eighteen to twenty inches in thickness, on which the tooth of time makes exceedingly small impression.

The name "Flint hills" is misleading. These hills, or high table-lands, gently sloping to the west, contain no strata or ledges of flint. The thin deposit of chert, styled flint, found on the surface of the summits of the hills in Butler county, is derived from nodules of that material occurring in the limestone rock of that locality, the superimposed layers having weathered away, leaving the indestructible flint nodules on the surface. These have broken into fragments by the action of the elements, fire being an active agent. In the Walnut river, above Arkansas City, are large beds of this broken flint, washed down from the hills and tributary streams in time of flood, in which are found many buffalo bones and skulls. Indian arrow points are often found along the railroad tracks, where this gravel is used for ballast.

In the Kaw reservation, on the summit of the hills are ancient quarries where some primitive people obtained flint nodules from which to make arrow-heads, spears, and knives. To the west there is no stone in Kansas or the territory suitable for that purpose.

There is no lead or zinc or other valuable metals in these hills, as many sup-